

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To: LESTER L. HEWITT
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PCT

NOTIFICATION OF TRANSMITTAL OF INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of Mailing
(day/month/year)

12 JUN 2000

Applicant's or agent's file reference

A97139WO

IMPORTANT NOTIFICATION

International application No.

PCT/US99/03888

International filing date (day/month/year)

24 FEBRUARY 1999

Priority Date (day/month/year)

02 MARCH 1998

Applicant

WILLIAMS TOOL COMPANY, INC.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices)(Article 39(1))(see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

RECEIVED

Akin, Gump, Strauss,
Hauer & Feld, L.L.P.

JUN 14 2000

Docket by

Action

Due date

Name and mailing address of the IPEA/US
Commissioner of Patents and Trademarks
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Washington, D.C. 20231

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PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference A97139WO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US99/03888	International filing date (day/month/year) 24 FEBRUARY 1999	Priority date (day/month/year) 02 MARCH 1998
International Patent Classification (IPC) or national classification and IPC IPC(7): E21B 7/12, 21/10, 21/12 and US Cl.: 175/7, 214, 215		
Applicant WILLIAMS TOOL COMPANY, INC.		

<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of <u>4</u> sheets.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority. (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of <u>9</u> sheets.</p> <p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of report with regard to novelty, inventive step or industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application 	
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Date of submission of the demand 09 SEPTEMBER 1999	Date of completion of this report 04 MAY 2000
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer HOANG DANG
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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US99/03888

I. Basis of the report

1. With regard to the elements of the international application:*

☐ the international application as originally filed☒ the description:

pages (See Attached)

, as originally filed

pages , filed with the demand

pages , filed with the letter of

☒ the claims:

pages (See Attached)

, as originally filed

pages , as amended (together with any statement) under Article 19

pages , filed with the demand

pages , filed with the letter of

☒ the drawings:

pages (See Attached)

, as originally filed

pages , filed with the demand

pages , filed with the letter of

☒ the sequence listing part of the description:

pages (See Attached)

, as originally filed

pages , filed with the demand

pages , filed with the letter of

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).☐ the language of publication of the international application (under Rule 48.3(b)).☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in printed form.☐ filed together with the international application in computer readable form.☐ furnished subsequently to this Authority in written form.☐ furnished subsequently to this Authority in computer readable form.☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.4. ☒ The amendments have resulted in the cancellation of:☒ the description, pages NONE☒ the claims, Nos. N O N E☒ the drawings, sheets/fig NONE5. ☒ This report has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

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V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. statement**

Novelty (N)	Claims <u>1-10</u>	YES
	Claims <u>NONE</u>	NO
Inventive Step (IS)	Claims <u>3</u>	YES
	Claims <u>1, 2, and 4-10</u>	NO
Industrial Applicability (IA)	Claims <u>1-10</u>	YES
	Claims <u>NONE</u>	NO

2. citations and explanations (Rule 70.7)

Claims 1, 2 and 4-10 lack an inventive step under PCT Article 33(3) as being obvious over Harrison (US 3,638,721) in view of Neath (US 4,046,191) or Jones (US 3,827,511).

Harrison discloses the invention as claimed except for the steps of "pressurizing the fluid..." or "controlling the pressure of the fluid..." and "drilling a borehole below the casing...". However, Neath '191 (col. 1, lines 12-53) or Jones '511 (col. 1, lines 1-60) shows that it is well known that during the course of drilling a borehole, when a formation with a pressure greater than the hydrostatic pressure in the well is encountered (i.e., a "kick" or an "abnormal pore pressure environment"), the pressure of the drilling mud is increased to a pressure equal to or greater than the encountered formation by adjusting a choke at the return line and by using a heavier drilling fluid to control the "kick" or to stabilize the well. After the well has been stabilized, the drilling is then resumed with the heavier drilling mud and at a pressure at least equal to the encountered formation (or abnormal pore pressure environment). It is noted that the claims do not preclude the use of a heavier mud or the use of a choke to increase the borehole pressure. Therefore, the recited method steps do not distinguish from the resumed drilling operation through the abnormal pore pressure environment after the borehole pressure has been stabilized by using a heavier mud and/or a choke to increase or control the pressure of the fluid in the borehole while drilling through the abnormal pore pressure environment.

As for claims 7, 8 and 10, see "housing" 22, "first housing opening" (upper end of 22), "second housing opening" (at 60) and "third housing opening" (lower end of 22), "inner member" 41, "outer member" 43, "seal 40" and "pressure controlling device" (the choke connected to mud return 60 and/or pump in communication with drill pipe 20 as taught by Neath '191 or Jones '511).

Claim 3 meets the criteria set out in PCT Article 33(2)-(4), because the prior art does not teach or fairly suggest a method (Continued on Supplemental Sheet.)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US99/03888

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Boxes I - VIII

Sheet 10

I. BASIS OF REPORT:

This report has been drawn on the basis of the description,
page(s) 1-4, 7-10, 12, 13, and 16, as originally filed.
page(s) NONE, filed with the demand.
and additional amendments:
Pages 5, 6, 11, 14 and 15, filed with the letter of 06 March 2000.

This report has been drawn on the basis of the claims,
page(s) NONE, as originally filed.
page(s) NONE, as amended under Article 19.
page(s) NONE, filed with the demand.
and additional amendments:
Pages 17-20, filed with the letter of 06 March 2000

This report has been drawn on the basis of the drawings,
page(s) 1-14, as originally filed.
page(s) NONE, filed with the demand.
and additional amendments:
NONE

This report has been drawn on the basis of the sequence listing part of the description:
page(s) NONE, as originally filed.
pages(s) NONE, filed with the demand.
and additional amendments:
NONE

5. (Some) amendments are considered to go beyond the disclosure as filed:
NONE

V. 2. REASONED STATEMENTS - CITATIONS AND EXPLANATIONS (Continued):
for controlling a subsea borehole fluid pressure as claimed and including the step of "moving fluid from said housing into the sea".

----- NEW CITATIONS -----

NONE

pressurization is controlled by formation fracture resistance, and the borehole pressure must be maintained below this pressure. The pressure housing assembly allows for the drilling of a borehole below the conductor casing into an abnormal pore pressure environment while maintaining the borehole fluid pressurization below the fracture pressure of the borehole in the abnormal pore pressure environment. Advantageously, a method is provided for drilling a borehole into the subsea abnormal pore pressure environment.

A better understanding of the present invention can be obtained when the following detailed description of the preferred embodiment is considered in conjunction with the following drawings, in which:

Fig. 1 is an elevational view of a drilling method where an abnormal pore pressure environment has resulted in an undesired flow path from the well to the sea floor;

Fig. 2 is an elevational graphic view of a floating vessel using a conventional riser for drilling through an abnormal pore pressure environment;

Fig. 3 is a perspective view of the pressure housing assembly of the present invention including a housing, a bearing assembly, a seal and a pressure control device;

Fig. 4 is an exploded view of the present invention shown in Fig. 3;

Fig. 5 is an exploded elevational view of the pressure housing assembly shown in Fig. 4, further including a fastening and sealing member that is actuated by a running collar connected to a drill string;

Fig. 6 is a section view of the pressure housing assembly as shown in Fig. 3;

Fig. 7 is an elevational graphic view of the present invention using the pressure housing assembly as shown in Figs. 3-6;

Fig. 8 is an elevational graphic view of the effects of losing fluid with additives at the casing shoe while performing the method of the present invention;

Fig. 9 is an elevational view of the preferred embodiment of the invention for drilling in a subsea borehole;

Fig. 10 is an elevational view of the preferred embodiment of the invention used to drill into an abnormal pore pressure environment including an abnormally pressured aquifer;

Figs. 11A, 11B, and 11C are elevational views of the steps for removal of preferred embodiment of the invention after drilling into the abnormal pore pressure environment including disengaging

the fastening and sealing member, as best shown in Fig. 11A, and removing the pressure housing assembly from the borehole using the running collar on a drill string, as best shown in Figs. 11B and 11C;

Fig. 12A is a graph of a casing design if conventional drilling techniques and riser sizes are used for drilling the example case discussed in the background of the invention;

Fig. 12B is a graph of the extended benefits of the present invention providing a second casing of larger diameter than the conventional drilling method, as shown in Figs. 2 and 12A; and

Fig. 13 is an alternative embodiment of the present invention sealingly positioned on a conventional blowout preventer stack attached to a wellhead extending from a conductor casing in a subsea borehole.

The preferred embodiment of the pressure housing assembly 15 is illustrated in Figs. 3-12 and an alternative embodiment of the pressure housing assembly 15A is illustrated in Fig. 13. The preferred embodiment of a pressure housing assembly, generally indicated at 15, includes a rotating blowout preventer or rotating control head, generally indicated at 38, and best shown in Figs. 3, 4, 5 and 6. The control head 38 is similar to the rotating blowout preventer disclosed in U.S. Patent No. 5,662,181, that is assigned to the assignee of the present invention and incorporated herein by reference for all purposes. Contemplated modifications to the '181 rotating blowout preventer include deletion of the kelly driver and the corresponding drive lugs located on the top rubber drive 40. Additionally, the clamp cylinder and drilling mud fill line could be deleted. However, the housing 44 preferably includes three return outlets 46, 48 and 50 (not shown). The return outlets 46 and 50 are preferably connected to redundant choking or pressure control devices, such as pressure control device 52, shown in Figs. 3 and 6 and as discussed below in detail. The return outlet 48 is used for an orifice valve, as discussed below in detail. Because the pressure housing assembly 15 is preferably self contained, a self contained lubrication unit 54 is preferably provided for communication with the lubricant inlet fitting, as disclosed in the '181 patent, to provide lubrication to the sealed bearing assembly, as discussed below in detail. The self contained pressure housing assembly 15, including the control head 38 and pressure control device 52, will not require long hydraulic hose bundles or electrical wires run from a floating vessel to the sea floor. It is also contemplated that the cooling water inlet and outlet fittings

tripping the drill string 66. The remotely operated vehicle could also be used to check for flow and make sure the well is dead after the circulating kill fluid 116 is moved into the annulus 100. The remotely operable vehicle could also be used to monitor pressure and actuate the orifice valve 98 when kill mud is being circulated, thereby eliminating the need for any special provisions for remotely actuating the orifice valve 98.

It is contemplated that the first prototype of the present invention will have a remotely operated vehicle docked to the pressure housing assembly 15 after it has been set and run. Annular pressure and flow rate could be continuously transmitted to the surface through the remotely operated vehicle umbilical and the remotely operated vehicle could be used to adjust the annular pressure regulator 52 set point. Also, it is contemplated that later models may use an on board computer which could take care of simple control functions and transmit data to the surface via acoustic, radio, laser, mud pulse, fiber-optic or an electrical style telemetry system. Instructions would also be sent to the on-board computer by one of the same forms of data transmission. A reliable system of this type could provide more flexibility and could prove cost effective by eliminating the need for any remotely operated vehicle intervention.

Turning now to Fig. 13, a subsea pressure housing assembly 15A, as discussed above, is mounted on top of an annular BOP preventer ABOP of a subsea blowout preventer stack BOPS connected to a wellhead 126. In this alternative embodiment, the casing type packer assembly 90 would not be used because it would interfere with the stack BOPS. The pressure housing assembly 15A would be mounted on top of the annular preventer ABOP (before running the BOP stack) using a fastening and sealing assembly 90'. Because the BOP stacks require a hose bundle to remotely actuate BOP components, the fastening and sealing assembly 90' could be a hydraulically actuated clamp, such as a Cameron HC Collet connector.

Turning now to Figs. 7-11A, 11B, and 11C, the method for operation of the present invention is illustrated. In particular, Fig. 7 illustrates the possible casing size and setting depth selections for the first two casings run into an example well drilled to control borehole pressures using the method of the present invention. The properly installed pressure housing assembly 15, as discussed above, would maintain a back pressure on the fluid in the annulus 100 while drilling with the drill string 66. The pressure housing assembly 15 provides back pressure in

IPEA/US 06 MAR 2000

15

116 would be pumped into the well. As the kill mud 116 moved up the annulus 110 more hydrostatic pressure would be placed on the hole 128. To offset this pressure increase, the pump 53 would be slowed down to reduce the back pressure. Once the kill mud reached the mudline of the sea floor SF, the back pressure would be reduced to zero. The running collar 92 would engage the packer assembly 90 at its bottom to release it. The whole self contained pressure housing assembly 15 would then be tripped up to the floating vessel 22 supported by the running collar 92. As discussed above, the mud 116 in the hole could prevent any flow from being produced. Although this mud 116 would not be recovered when the casing 108 is run into the hole and the hole cemented, the waste would be limited to the volume of the well bore as best seen in Figs. 8 and 11C.

After completing the casing of shallow, large diameter portion of the well, a conventional riser or other method could be used to drill the smaller diameter and deeper sections of the well. While the method and apparatus of the present invention is to be used where the drilling fluid can be economically discarded after a single pass, it offers a simple and effective aid in eliminating the physical and economic constraints associated with the initial phases of drilling a well in deep water.

It can now be understood that the maximum depth in which casing larger than the BOP stack or riser can be set controls the maximum total depth of the well and the maximum diameter of the final production casing. The advantages of larger production casings are higher production rate potentials and greater well bore utility for future drilling operations, such as side-tracking. As can now be seen, the subsea pressure housing assembly 15, when applied to riserless drilling, increases the maximum total depth to which a well can be drilled in a given water depth by increasing the depth that can be drilled before a riser becomes necessary. Substantial cost savings can also be realized by using smaller floating vessels (without riser capabilities) to drill the shallow, large-diameter hole sections to a depth below the high risk shallow water aquifers. Casing could then be set to seal off the water flows, and the location could then be temporarily abandoned until a larger floating vessel was available to finish drilling the well to the target objective. The smaller floating vessel needed for the present invention would be cheaper to operate than the current large floating vessels. Also, if wells were lost because of water flows, the financial impact would be much less than if the

CLAIMS

- 1 1. Method for controlling a subsea borehole fluid pressure, comprising the steps
2 of:
3 positioning a portion of a tubular below the subsea mudline;
4 moving a fluid in the tubular that exerts a pressure less than a pore pressure of
5 an abnormal pore pressure environment;
6 pressurizing the fluid to increase the fluid pressure to control the pore pressure
7 of the abnormal pore pressure environment, and
8 forming a borehole below the tubular and into the abnormal pore pressure
9 environment while controlling the pore pressure of the abnormal pore pressure
10 environment.
- 1 2. Method of claim 1, further comprising the steps of:
2 sealingly positioning a housing with the tubular;
3 sealingly positioning a string with the housing so that the string extends
4 through the housing and into the borehole;
5 moving the fluid, that exerts a pressure less than the pore pressure of the
6 abnormal pore pressure environment, into the tubular; and
7 controlling the pressure of the fluid in the borehole between a borehole
8 pressure substantially equal to or greater than the pore pressure of the abnormal pore
9 pressure environment, and a borehole pressure substantially equal to or less than the
10 fracture pressure of the abnormal pore pressure environment while forming the
11 borehole in the abnormal pore pressure environment.
- 1 3. Method of claim 1, further comprising the steps of:
2 sealingly positioning a housing with the tubular;
3 sealingly positioning a string with the housing so that the string extends
4 through the housing and into the borehole;

5 rotating the string relative to the housing while maintaining the seal between
6 the string and the housing;
7 moving fluid, that exerts a pressure less than the pore pressure of the abnormal
8 pore pressure environment, into the borehole;
9 controlling the pressure of the fluid in the borehole as the borehole extends into
10 the abnormal pore pressure environment; and
11 moving fluid from said housing into the sea.

1 4. Method of claim 1, further comprising the steps of:
2 sealingly positioning a housing with the borehole;
3 sealingly positioning a string with the housing so that the string extends
4 through the housing and into the borehole; and
5 rotating the string relative to the housing while maintaining the seal between
6 the string and the housing.

1 5. Method of claim 1, further comprising the steps of:
2 sealingly positioning a housing with the borehole;
3 positioning a string with the housing so that the string extends through the
4 housing and into the borehole;
5 rotating the string relative to the housing while maintaining a seal between the
6 string and the housing; wherein said housing having a first housing opening, a second
7 housing opening and a third housing opening, and further comprising:
8 a bearing assembly having an inner member and an
9 outer member and disposed with said first housing opening,
10 said inner member rotatable relative to said outer member and
11 having a passage through which the string may extend; and
12 the seal sealably engaging the string with the inner
13 member;
14 moving a fluid into the borehole;
15 increasing the pressure of the fluid in the borehole;
16 a pressure control device in communication with said second housing opening
17 to control pressure within the housing; and

18 an orifice in communication with said third housing opening, said orifice
19 having a predetermined size to provide sufficient back pressure in the borehole to control the
20 fluid pressure.

1 6. System for controlling a subsea borehole fluid pressure adapted for use with a
2 portion of a tubular positioned below the mudline, comprising:

3 a pump for moving a fluid in the tubular, said fluid exerting a pressure less
4 than a pore pressure of an abnormal pore pressure environment, said fluid being
5 pressurized by the pump to control the pore pressure of the abnormal pore pressure
6 environment, and

7 a forming device for forming a borehole below the tubular and into the
8 abnormal pore pressure environment while the pore pressure of the abnormal pore
9 pressure environment is controlled.

1 7. System of claim 6 further comprising:

2 a housing having a first housing opening, a second housing opening and a third
3 housing opening;

4 a bearing assembly having an inner member and an outer member and
5 disposed with said first housing opening, said inner member rotatable relative to said
6 outer member and having a passage through which a string may extend;

7 a seal to sealably engage the string with the inner member;

8 a pressure control device in communication with said second housing opening
9 to control pressure within said housing; and

10 said third housing opening sealingly positioned with the tubular.

1 8. System of claim 6 further comprising:

2 a housing having a first housing opening, a second housing opening and a third
3 housing opening;

4 a string extending in said first opening;

5 a seal to sealably engage the string;

6 a pressure control device in communication with said second housing opening
7 to control pressure in said housing;

8. said third housing opening sealingly positioned with said tubular; and
9. said pump pressurizing the fluid in the borehole whereby said fluid, exerting a
10. pressure less than the pore pressure of the abnormal pore pressure environment before
11. being pumped, being pressurized by said pump and maintained by said pressure
12. control device to control the abnormal pore pressure environment while forming the
13. borehole in the abnormal pore pressure environment.

1. 9. System of claim 6 further comprising:
2. a pressure control device to control pressure in said tubular whereby said
3. pressure control device controlling the fluid pressure while the borehole is formed in
4. the abnormal pore pressure environment.

1. 10. System of claim 6 wherein said forming device is a rotatable string having a
2. bit, said system further comprising:
3. a housing having a first housing opening, a second housing opening and a third
4. housing opening;
5. a sealed bearing assembly having an inner barrel and an outer barrel and
6. disposed with said first housing opening, said inner barrel rotatable relative to said
7. outer barrel and having a passage through which the string having a bit may extend;
8. a seal moving with said inner barrel to sealably engage the string;
9. a pressure control device in communication with said second housing opening
10. to control pressure in said housing;
11. a fastening and sealing assembly disposed adjacent to said third housing
12. opening to sealably engage said housing with the tubular; and
13. said pump pressurizing the fluid in the borehole whereby said sealed bearing
14. assembly, said seal, said pressure control device and said fastening and sealing
15. assembly control the pore pressure of the abnormal pore pressure environment while
16. rotating the bit in the borehole.